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Surf Forecasting Using Directional Wave Spectra with the Navy Standard Surf Model

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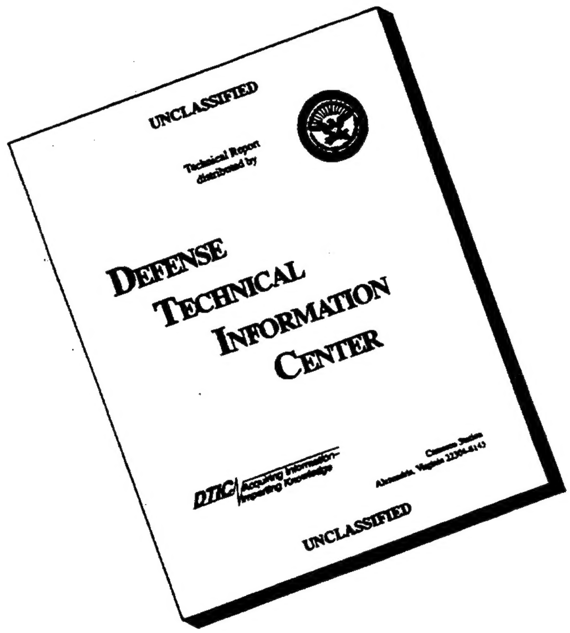

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13. ABSTRACT *(Maximum 200 words)*
A version of the Navy Standard Surf Model has been developed which allows users the option of generating surf forecasts based on WAM or Endeco Buoy directional wave spectra. The software, identified as SPE_SURF (version 1.0 Jun 96), allows input of standard surf model wave parameters, Regional WAM directional wave spectra, Global WAM directional wave spectra, or Endeco/YSI Type 1156 WAVETRACK Buoy System directional wave spectra. SPE_SURF has been tested using several Regional WAM spectra obtained from the Naval Oceanographic Office and several Endeco Buoy spectra obtained from the Naval Research Laboratory. This memorandum report documents model modifications to use these inputs.

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CONTENTS

SURF FORECASTING USING DIRECTIONAL WAVE SPECTRA WITH THE NAVY STANDARD SURF MODEL

1.0 INTRODUCTION

This memorandum report documents and describes modifications to a version of the Navy Standard Surf Model (NSSM), NCSCSURF, to increase its utility by allowing use of several types of input wave information. Recent advances in numerical wave forecasting, wave measurement technology, and sensor and Fleet communications, coupled with a change in naval strategy from a focus on deep water to shallow water, produced a need to modify the NSSM so that it can use different types of user-provided directional wave spectra. This memorandum report does not address surf model uncertainties and sensitivities to the different types of input.

When the NSSM was developed for shipboard use, there was no shipboard capability to obtain directional wave spectra in computerized formats for automated model input. In anticipation of automated use, the model was developed to internally use directional wave spectra with frequency and direction bands corresponding to the Global Spectral Ocean Wave Model operated by the Navy for forecasts. As an expedient approach for operational use, the model fits directional spectra considered to represent locally generated sea to user input wave heights, periods, and directions. Sea spectra thus derived can be superimposed optionally on swell spectra considered to be narrow-banded in frequency and direction. Sea or swell spectra can be used operationally by themselves if judged appropriate by the user.

Deep-water directional spectra (sea, swell, or sea and swell) are modified mainly by wave refraction to provide shallow-water directional spectra that drive the surf model. Wave parameters that drive the surf zone part of the model are calculated from directional spectra outside of the surf zone. When using versions of the surf zone part of the NSSM, most users provide input wave parameters even if input directional spectra are available. This approach may introduce unneeded uncertainties since model-fitted directional spectra may not match actual directional spectra. To remove this limitation, the NSSM has been modified to use actual directional spectra from three sources: the Regional WAM (Wave Model), the Global WAM, and the Endeco/YSI Type 1156 Wave Track Buoy.

This version of the NSSM, SPE_SURF, has been tested using Regional WAM spectra representing 0-, 24-, and 48-hour forecast conditions for a point offshore Hamlet's Cove, Eglin AFB, FL, in July and August 1994; for a point offshore Camp Pendleton, CA, in March and April 1995; and for a point in Onslow Bay, near Camp Legeune, NC, during Operation Purple Star in May 1996. SPE_SURF was also tested using several spectra from Endeco buoys moored at these three locations. WAM spectra were provided by the Ocean Modelling Division of the Naval Oceanographic Office (NAVOCEANO) and Endeco buoy spectra were provided by the Remote Sensing Applications Branch of the Naval Research Laboratory (NRL).

Owing to the differences in the spectral frequencies of the older version of the NSSM and those of the Regional WAM, the deep-water refraction software, REFRACT, that accompanies the NSSM was modified and tested using Purple Star Regional WAM spectra.

This report describes the hardware and software used to produce the programs SPE_SURF and WAM_REFR; describes the directional wave spectrum options in SPE_SURF: internally generated, WAM, and Endeco; gives frequencies, directions, and units of the spectra; describes the deep-water wave refraction options, software limitations, and inputs to the model; gives instructions for running

the model; and, finally, describes test routines available. These routines will be useful for learning to use the software and to identify compiler dependencies.

2.0 SOFTWARE

SPE_SURF and WAM_REFR were written in Fortran using a Sun Sparc 2 workstation and Sun OS 4.1.3. The Fortran coding was kept as generic as possible, but there may be compiler dependencies. Test routine input and output files should be used to identify possible inconsistencies.

SPE_SURF (Version 1.0, Jun 96) is a version of the 1992 version of the surf model, NCSCSURF, which is a version of the NSSM developed for operation on DTC-2 computers (Earle 1992). The size of the executable is 114 kilobytes. WAM_REFR (Version 1.0, Jun 96) is a version of the 1988 program REFRACT; the size of the executable is 47 kilobytes.

The user should refer to Earle (1989) and Earle (1991) for an understanding of the scientific basis of the model software and the programming methods that were used to develop it. The modifications described herein are solely input improvements; the model physics and numerical methods remain unchanged from NCSCSURF. There are slight additions to the output content. The user should also refer to Earle (1988) for an understanding of the input and output information associated with the model.

3.0 DIRECTIONAL WAVE SPECTRUM OPTIONS

There are four types of directional wave spectra that may be used with SPE_SURF.

3.1 Internally Generated Spectra

The method for deriving the directional wave spectrum from input wave parameters is described in detail in Earle (1989, pp. 4–9). With this method, the user inputs height, period, and direction of wind and wave swells. Wind wave parameters are used to construct a modified Pierson-Moskowitz (PM) wave spectrum (Pierson and Moskowitz 1964). The PM spectrum describes the wave spectrum for a fully risen sea for a given wind speed. Since, under most conditions, the sea will not be fully arisen, the peak of the PM spectrum is placed at the frequency corresponding to the input dominant wind wave frequency. The spectrum is normalized so that the total energy corresponds to that of the input significant wind wave height. The energy is then spread ±90° about the dominant wind wave direction using a cosine to the fourth power spreading function. Swell is considered narrow-banded in both frequency and direction.

There is one set of frequencies and two sets of directions used with this method. The center frequencies of the 15 spectral intervals correspond to the following periods in seconds:

3.2, 4.8, 6.3, 7.5, 8.7,

9.7, 10.9, 12.4, 13.8, 15.0,

16.4, 18.0, 20.0, 22.5, 25.8.

These frequencies are those that were used in the Global Spectral Ocean Wave Model.

In most cases, 24 directional sectors will be used in the calculations. The centers of the sectors, in degrees clockwise from north, representing the directions from which the energy is coming are:

7.5, 22,5, 37.5, . . . 322.5, 337.5, 352.5.

If, as an option, only 12 directions are used (in some) refraction calculations, they are:

15, 45, 75, . . . 285, 315, 345.

Using internally generated spectra may be less desirable than using actual spectra, owing to imprecision in some observational techniques and in the mathematical representation of wave spectra from wave parameters alone, but is valuable in situations where offshore conditions from a wave model fail to properly describe conditions near shore due to any of several possible local influences.

3.2 WAM

The WAM is the latest wave model employed at the Fleet Numerical Meteorology and Oceanography Center (FNMOC) and NAVOCEANO for operational Fleet use. It is a so-called third-generation wave model. Unlike first- and second-generation models that rely heavily on parameterized source and dissipation terms, the WAM computes the ocean wave spectrum by direct integration of the energy balance equation. Complete descriptions of the WAM, including physics, data assimilation, numerical schemes, and applications are given by Komen et al (1994) and the WAMDI Group (1988). An overview of the recent use of the WAM for operational purposes, including validation studies, is given by Wittmann et al (1995).

The WAM has been implemented as a global wave model (GWAM) and as a regional wave model (RWAM). There are differences between the two in grid resolution, wind forcing function, areal coverage, model and wind forcing step times, and operational run times. An important difference between the GWAM and the RWAM is that the RWAM implementations can be run with shallow-water physics to include the effects of bottom friction and wave refraction. The RWAM has been used for several regions by both FNMOC and NAVOCEANO. At FNMOC, the implementations of the RWAM are IOWAM, MEDWAM, and KORWAM, covering the Indian Ocean, Mediterranean Sea, and seas in the vicinity of Korea, respectively. Each implementation varies in grid resolution, model step time, and areal coverage.

The directional sectors of the GWAM and RWAM wave spectra are the same. The 24 center directions represent energy toward, in degrees clockwise from north, as follows:

0, 15, 30, . . . 315, 330, 345.

The spectral frequencies produced by the FNMOC GWAM differ from those produced by the NAVOCEANO GWAM.

3.2.1 FNMOC GWAM

The periods corresponding to the center frequencies of the FNMOC WAM are as follows:

2.4, 2.7, 2.9, 3.2, 3.6,

3.9, 4.3, 4.7, 5.2, 5.7,

6.3, 6.9, 7.6, 8.4, 9.2,

10.1, 11.2, 12.3, 13.5, 14.9,

16.3, 18.0, 19.8, 21.7, 23.9.

3.2.2 NAVOCEANO GWAM and RWAM

The particular implementations of the RWAM used for testing this software were developed by NAVOCEANO. The Hamlet's Cove surf model runs were tested using spectra from MEXWAM, the Camp Pendleton spectra were from SCAWAM, and the Onslow Bay spectra were from QSWAPSNC. The SCAWAM does not include shallow-water physics. The frequencies and directions for each of the RWAM implementations are the same. The 25 center frequencies of the wave spectrum correspond to the following periods in seconds:

3.0, 3.4, 3.7, 4.1, 4.5,

4.9, 5.4, 5.9, 6.5, 7.2,

7.9, 8.7, 9.6, 10.5, 11.6,

12.7, 14.0, 15.4, 16.9, 18.6,

20.5, 22.5, 24.8, 27.3, 30.0.

These frequencies are also used with the NAVOCEANO implementation of GWAM.

A sample NAVOCEANO RWAM spectrum file is given in Appendix 1.1. The file contains specific valid time and location information, the number of directional sectors, the number of frequency intervals, the center frequency of the first interval, f_1, and the initial direction (toward). The frequency ratio, r, is used for calculating the *n*th center frequency of each frequency interval, f_n, such that

$$f_n = f_1 \, r^{(n-1)}.$$

The spectral energy densities given are in units of meter-squared per hertz-radian; thus, for surf model calculations, the energy spectrum must be converted to energy variance in units of feet squared. Since WAM directions are directions toward, the spectrum must also be rotated 180° within SPE_SURF.

3.3 Endeco Buoy Spectra

SPE_SURF has the option to use Endeco/YSI Type 1156 WAVE-TRACK Buoy System spectra. The time series of buoy motion are used to derive the directional wave spectrum. YSI software produces spectra derived from four methods: Longuet-Higgins, Maximum Likelihood, Maximum Entropy, and Bandpass Filtering. SPE_SURF uses only Endeco spectra derived by bandpass filtering. A sample Endeco output is shown in Appendix 1.2. The sample gives units, frequencies, and directions (from). To use this output, the Endeco spectrum file must be preprocessed by the Fortran program INPUT2, which reads the Endeco Quick-Look Frequency-Direction Spectrum, multiplies each of the non-zero spectral values by the multiplier given, and then converts the result from units

of foot-squared per hertz-degree into units of feet squared. The output file from INPUT2 is the input file to SPE_SURF.

4.0 WAVE REFRACTION OPTIONS

Details for building and using a refraction file are described in detail in Earle (1988). Since REFRACT has different frequencies and directions from the WAM, a new program, WAM_REFR, was written that has RWAM frequencies and directions. No deep-water refraction program is yet available for GWAM or Endeco spectra. WAM_REFR creates refraction coefficients for each element of the WAM's 24-direction by 25-frequency spectrum.

5.0 LIMITATIONS

SPE_SURF internally generates either GWAM or RWAM directions and frequencies, and although these frequencies and directions are used by NAVOCEANO and FNMOC, they are subject to change. If the frequencies or directions are changed, the software code must be modified.

SPE_SURF has not been tested with either FNMOC or NAVOCEANO GWAM. The spectrum files from NAVOCEANO, GWAM or RWAM, are identical in format, frequencies, and directions, so using GWAM from NAVOCEANO should be no different from using RWAM. SPE_SURF includes FNMOC GWAM frequencies, but they have not been tested.

Testing has demonstrated that the Endeco Quick-Look output is not always uniform in format. The user running the utility INPUT2 should ensure that the multiplier at the top of the directional wave spectrum in the Endeco Quick-Look must always be in the 91st line of the Quick-Look file. This will require, at times, use of a text editor to add or delete extra lines.

6.0 SOFTWARE INPUT

SPE_SURF is run with input information gathered from at least one file, and possibly as many as four files, depending on the options used: input file, near-shore depth file, refraction file, and spectrum file.

A sample input file for SPE_SURF is shown in Appendix 2.0. This file contains all the command line inputs that a user would enter using the original 1988 version of the model. Since SPE_SURF cannot be run interactively, it must be run using an input file. Detailed descriptions of each input parameter in this file, except the last, are given in Earle (1988). The last line contains the spectrum file name; if none is used, this line should not exist. Some inputs to the model are rigidly formatted, so it is best to use the same format as the sample. Previous versions of the NSSM allowed multiple entries of the line beginning with time_sea_swell_wind_tide; SPE_SURF does not allow this. The file names of the output file (which is the surf forecast), the near-shore depth file name, and the spectrum file name should be no more than 14 characters in length. If an input spectrum is used, it is important to note that the input wave parameters in the line time_sea_swell_wind_tide are not used but that the wind and tide information is used. In this case, the user can make the wave parameters all zeros or all 9999 as a reminder that they will be bypassed in software calculations.

Optional files for SPE_SURF include the near-shore depth profile, the wave refraction file, and the spectrum file. Earle (1988) gives the procedures for making and using the near-shore depth file and the wave refraction file. Appendices 3.0 and 4.0 are respective samples. The directional wave spectrum file must be one of two types: WAM or Endeco. Any WAM spectrum file of the format found in Appendix 1.1 can be used, but the Endeco spectrum file of the format in Appendix 1.2 must first be processed before SPE_SURF can utilize it.

The Endeco Quick-Look file can be processed using program INPUT2 in Appendix 5.0. This program reads the name of the input Endeco file and creates an output file with a name containing the same date and time information as in the Endeco file name. INPUT2, in its present form, can only use Endeco file names that end in 00 and c0, which indicate 0000 GMT and 1200 GMT, respectively. If the Endeco file name ends in something different, the program must be changed accordingly. The program is run by typing the command:

input2 *fn* ,

where input2 is the compiled executable and *fn* is the name of the Endeco file. The program produces three output files: a spectrum file, a frequency file, and a direction file. Only the spectrum file is used with SPE_SURF. The processed spectrum file name is placed at the end of the input file in the same way as the WAM spectrum file.

WAM_REFR produces the refraction file (Appendix 4.0) from the depth grid file. A sample depth grid file is shown in Appendix 6.0. WAM_REFR is run in the same way as REFRACT in Earle (1988, pp. 67–80).

7.0 RUNNING THE SOFTWARE

SPE_SURF is run by entering the following:

spe_surf *fn* *n* ,

where *fn* is the name of the input file and *n* is the run option. The run options follow:

1 Internally generated spectrum

2 NAVOCEANO WAM or FNMOC RWAM

3 FNMOC GWAM

4 Endeco

The detailed output from SPE_SURF using the input file in Appendix 2.0 is shown in Appendix 7.0.

8.0 TEST ROUTINES

The following files (with sizes in bytes) comprise the test routines available to verify the operation of the software:

HAMCOVE1.DEP	2,149
ONSLOW.DEP	9,358

SPE94082100	10,608
SPE96050600	10,576
01482100.STD	12,100
H082100.DAT	21,701
HAMCOVE1.IN	641
HAMCOVE2.IN	677
HAMCOVE4.IN	677
ONSLOW.IN	725
ONSLOW.GRD	4,644
ONSLOW.FRC	10,113
HAMCOVE1.OUT	7,417
HAMCOVE2.OUT	7,260
HAMCOVE4.OUT	7,260
ONSLOW.OUT	53,737

Information in these files is associated with conditions at Hamlet's Cove at 0000 GMT 21 August 1994 and at Onslow Bay at 0000 GMT 6 May 1996. The input depth files are HAMCOVE1.DEP and ONSLOW.DEP. The RWAM spectrum file for Hamlet's Cove is SPE94082100 and for Onslow Bay is SPE96050600. The Endeco Quick-Look directional wave information file is O1482100.STD, and the Endeco spectrum file (produced by INPUT2 and O1482100.STD) is H082100.DAT. The .IN files are input files. HAMCOVE1.IN will produce surf model results based on internally generated spectra and considering straight coast refraction. HAMCOVE2.IN will produce RWAM results considering straight coast refraction. HAMCOVE4.IN will produce Endeco buoy results considering straight coast refraction. ONSLOW.IN will produce RWAM results considering offshore bathymetry-based deep-water wave refraction. The four .OUT files are the respective SPE_SURF surf forecasts.

The executable code and sample input and output files are available by contacting NRL Code 7240. Point of contact is Douglas May, (601) 688-4864.

9.0 ACKNOWLEDGMENTS

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APPENDIX 1.0 SAMPLE SPECTRUM FILES

Appendix 1.1 Sample Regional WAM Spectrum File

```
longitude =  273.2500
latitude =   30.2500
date = 9408210000.0
angles =   24.0
frequencies =   25.0
initial direction =   0.0000
initial frequency = 0.033333
frequency ratio = 1.100000
sight =  0.5660216E+00
thq =  0.1838053E+02
fmean =  0.3018309E+00
usnew =  0.2196216E+00
thwnew =  0.4775533E+02
 1 0.033333
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.5034012622E-35	.1813573473E-34	.8151708245E-34	.4575874159E-33
.3338874143E-32	.3550218908E-31	.7733350641E-30	.7346890881E-28
.1154182291E-25	.5673537523E-23	.2805396338E-22	.1691627263E-22
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.1308015587E-21	.4902302195E-25	.1262052269E-30	.2373357151E-30
.7256705667E-30	.2719817492E-29	.1269080420E-28	.7405056920E-28
.5639839729E-27	.6302320538E-26	.1450291276E-24	.1676543905E-22
.3648159550E-20	.1055080829E-17	.5203031449E-17	.2696809249E-17
10 0.078598			
.5567155644E-12	.3851412241E-12	.2119512424E-12	.8104764991E-13
.2313180711E-13	.9635481505E-14	.6189806562E-15	.1426922916E-16
.1691882919E-17	.4066281420E-21	.1669779862E-26	.1703959846E-26
.5502438745E-26	.2118740301E-25	.1017377816E-24	.6128294464E-24
.4840887424E-23	.5646845170E-22	.1366633812E-20	.3175624443E-18
.8058736039E-16	.2972173653E-14	.1315393663E-13	.1621080367E-13
11 0.086458			
.6897928261E-09	.2957880452E-09	.1091215528E-09	.3745453297E-10
.2087760665E-10	.1251127226E-10	.7224911850E-12	.6292576847E-14
.4953713698E-15	.8000677720E-19	.8953631823E-24	.1676667472E-23
.6713724088E-23	.2992157579E-22	.1636806335E-21	.1115353645E-20
.9960913310E-20	.1320476835E-18	.3687215549E-17	.1596667367E-14
.8961054937E-13	.8273078613E-12	.2335317689E-11	.9485681608E-11
12 0.095104			
.2733101271E-06	.8351942434E-07	.2303029385E-07	.8708972096E-08
.1504940774E-07	.6251543325E-08	.3325375921E-09	.9047598099E-12
.4143877295E-13	.4680362567E-17	.1294478779E-21	.2863287111E-21
.1310355646E-20	.6381352169E-20	.3788960091E-19	.2796350185E-18
.2708187890E-17	.3910808201E-16	.1207548538E-14	.4017222732E-12
.1308353480E-10	.8283785627E-10	.2408177596E-09	.3862303535E-08
13 0.104614			
.3134540646E-04	.7741098296E-05	.1722638423E-05	.6596870217E-06
.1884931064E-05	.6953639115E-06	.3488002265E-07	.4078799410E-10
.1167693583E-11	.9012573422E-16	.7125498346E-20	.1475808693E-19
.7706388091E-19	.4094858860E-18	.2641502739E-17	.2116231882E-16
.2228786070E-15	.3513963723E-14	.1193564636E-12	.2501092003E-10
.6105244778E-09	.3660094981E-08	.3300336170E-07	.8131943523E-06
14 0.115076			
.5058420130E-03	.1149108228E-03	.2354647472E-04	.1392668514E-04
.6658165912E-04	.2441099351E-04	.1135981480E-05	.4517586033E-09
.5962417112E-11	.4443745798E-15	.2029894662E-18	.3863685154E-18
.2403290770E-17	.1458461655E-16	.1076988139E-15	.9934485723E-15
.1214206896E-13	.2237187865E-12	.8775148569E-11	.6603639544E-09
.1259755108E-07	.1867661634E-06	.4153346810E-05	.5960289080E-04
15 0.126583			
.2337622321E-02	.4756757006E-03	.9091002293E-04	.1008993625E-03
.6732545482E-03	.1745136285E-03	.7072180844E-05	.1476572818E-08
.9755675259E-11	.5438719487E-14	.7968020054E-16	.7830890515E-17
.5804190120E-16	.4135192908E-15	.3617053846E-14	.3952037988E-13
.5674480817E-12	.1204863162E-10	.5078373234E-09	.1880589750E-07
.3238780362E-06	.9041583315E-05	.1665268309E-03	.8328154335E-03
16 0.139242			
.9400991708E-02	.1557732712E-02	.2632260897E-03	.6294644747E-03
.4883648593E-02	.8099559576E-03	.2623160832E-04	.4580151444E-08
.2909243239E-10	.5389032061E-12	.9586156266E-14	.1033701195E-15
.8215342992E-15	.6624421337E-14	.6767161397E-13	.8724299790E-12
.1466296082E-10	.3543153128E-09	.1543680893E-07	.3538753447E-06
.3921417517E-05	.9141847784E-04	.1054824370E-02	.3967658043E-02
17 0.153166			
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18 0.168482
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.1111067597E-01 .1030860157E-02 .2237328741E-04 .9046548328E-06
.7337577185E-07 .2441136751E-08 .1853340473E-10 .9337006920E-14
.2406683275E-14 .2935415893E-13 .5094562241E-12 .1211891014E-10
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.1227007518E-03 .2010052464E-02 .7426321203E-02 .1591325808E-01
19 0.185331
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.6104136729E-02 .5265059049E-03 .1001003402E-03 .2883233683E-04
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20 0.203864
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21 0.224250
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22 0.246675
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.1269704232E-16 .2416691571E-17 .7286475734E-15 .1807786379E-12
.4154108677E-10 .8205882533E-08 .9367197780E-06 .4591412349E-04
.1416857627E-02 .1198314699E-01 .3227241216E-01 .5214460442E-01
24 0.298477
.6814068391E-01 .9195611019E-01 .1262302708E+00 .1002310441E+00
.8535846977E-01 .2870158001E-01 .5413092977E-02 .7152860308E-03
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.3163673081E-16 .9369505014E-18 .3244050174E-15 .8578391145E-13
.2076884725E-10 .4436158573E-08 .5263108626E-06 .2687721856E-04
.8652802832E-03 .6450340733E-02 .1943561773E-01 .4313264989E-01
25 0.328324
.3255680090E-01 .4054996742E-01 .5484072120E-01 .6410908828E-01
.6815658559E-01 .3489348772E-01 .6627101339E-02 .7157856505E-03
.3292057046E-04 .2582510694E-06 .4169877267E-09 .1455010399E-12
.5931138290E-16 .4695066835E-18 .1693009246E-15 .4495778339E-13
.1087511611E-10 .2434794216E-08 .2986093292E-06 .1684761770E-04
.5279938440E-03 .3412383163E-02 .9885248275E-02 .2373563663E-01
count of records =          18
```

Appendix 1.2 Sample Endeco Buoy Report

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          Endeco/YSI, Inc.  Marion, MA  02738  U.S.A.   Ver  6/24/93
                 Type 1156 Directional Wave-Track Buoy
                    Digital Bandpass Filtering Method

Study started at : 21-AUG-94 at  0:00          Serial Number : 11560051
  Other Settings : LFNC                          Wave Points : 2048
Outputs Selected : SPD STD                    Wave Frequency : 1
       Data File : 01482100                   Units Selected : ENGLISH

          ************   ZERO-CROSSING STATISTICS   ************
```

NBR WAVES	MAX PERIOD (S)	PERIOD OF MAX HEIGHT (S)	MAX HEIGHT (FT)	SIG PERIOD (S)	SIG HEIGHT (FT)	MEAN PERIOD (S)	MEAN HEIGHT (FT)	H 1/10 PERIOD (S)	H 1/10 HEIGHT (FT)
621	7.00	3.00	2.98	3.45	1.62	3.29	1.03	3.45	2.03

```
            PROFILE OF MAXIMUM WAVE AT 1.000 SECOND INTERVALS
               -1.56   1.42   -.09   -.94    .54
```

Study started at : 21-AUG-94 at 0:00

************ SPECTRAL ANALYSIS STATISTICS ************

SIG WAVE HEIGHT (H 1/3) = 1.84 FT AVERAGE ZERO CROSSING PERIOD = 3.31 SEC
RMS WAVE HEIGHT = 1.30 FT AVERAGE PERIOD = 3.38 SEC

Maximum energy is 1.741 (FT-SQ/HZ) at 3.33 (SEC) from 223. (DEG).

FREQUENCY BANDNUMBER	CENTER FREQUENCY (HZ)	CENTER PERIOD (S)	ENERGY DENSITY (FT-SQ/HZ)	MEAN DIRECTION (DEG)	STANDARD DEVIATION (DEG)
1	.03	33.33	.000	43.	7.0
2	.04	25.00	.000	89.	11.0
3	.05	20.00	.000	267.	9.1
4	.06	16.67	.000	265.	7.0
5	.07	14.29	.022	218.	6.7
6	.08	12.50	.021	228.	5.3
7	.09	11.11	.019	234.	3.9
8	.10	10.00	.018	211.	4.5
9	.11	9.09	.045	215.	4.9
10	.12	8.33	.072	207.	4.1
11	.13	7.69	.051	223.	3.5
12	.14	7.14	.043	217.	3.8
13	.15	6.67	.088	183.	4.0
14	.16	6.25	.076	212.	2.9
15	.17	5.88	.177	215.	3.0
16	.18	5.56	.203	200.	2.8
17	.19	5.26	.284	206.	1.8
18	.20	5.00	.188	196.	1.7
19	.21	4.76	.196	200.	2.6
20	.22	4.55	.263	208.	2.6
21	.23	4.35	.684	221.	1.0
22	.24	4.17	1.085	222.	.8
23	.25	4.00	1.481	227.	.7
24	.26	3.85	1.366	215.	.9
25	.27	3.70	1.261	217.	1.0
26	.28	3.57	1.385	218.	1.2
27	.29	3.45	1.633	222.	1.0
28	.30	3.33	1.741	223.	.8
29	.31	3.23	1.278	225.	1.1
30	.32	3.13	1.267	218.	1.1
31	.33	3.03	1.285	220.	1.0
32	.34	2.94	1.067	223.	1.1
33	.35	2.86	.645	215.	1.6
34	.36	2.78	.567	217.	1.5
35	.37	2.70	.383	228.	1.6
36	.38	2.63	.616	228.	1.4
37	.39	2.56	.455	236.	2.1
38	.40	2.50	.559	228.	1.3
39	.45	2.22	.375	227.	2.2
40	.50	2.00	.179	225.	2.9
41	.55	1.82			
42	.60	1.67			
43	.65	1.54			
44	.70	1.43			
45	.75	1.33			
46	.80	1.25			
47	.85	1.18			
48	.90	1.11			
49	.95	1.05			
50	1.00	1.00			

NOTE: Band #1 energy contains frequency components beyond the range of the buoy

Study started at : 21-AUG-94 at 0:00

QUICK-LOOK PLOT OF FREQUENCY/DIRECTION SPECTRUM
FOR THE DIGITAL BANDPASS FILTERING METHOD

ENTRIES ARE SCALED LINEARLY FROM 0 TO 50
PEAK VALUE CORRESPONDS TO SPECTRAL DENSITY OF .03793(FT-SQ/HZ*DEG)

.03 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.04 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.05 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.06 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.07 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.08 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.09 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.10 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.11 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.12 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.
.13 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.14 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
.15 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.
.16 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.
.17 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	3	2	2	.	.	1	1	.	.	.	.	.	.	.	.
.18 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	2	2	1	4	2	1	.	.	.	.	.	.	.	.	.	.	.
.19 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	3	4	8	5	.	.	.	.	.	.	.	.	.	.	.	.
.20 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	3	3	3	2	2	1	.	.	.	.	.	.	.	.	.	.	.	.
.21 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	3	3	2	1	.	.	.	.	.	.	.	.	.	.	.	.
.22 :	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	2	.	.	.	3	4	3	2	1	.	.	.	.	.	.	.	.	.	.
.23 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	4	11	20	15	6	3	1	.	.	.	.	.	.	.	.	.
.24 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	5	7	23	29	19	12	10	2	.	.	.	.	.	.	.	.	.
.25 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	5	19	37	44	28	7	2	1	.	.	.	.	.	.	.	.
.26 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	7	30	23	30	18	10	4	1	.	.	.	.	.	.	.	.	.
.27 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	5	7	11	22	16	14	16	8	2	1	.	.	.	.	.	.	.	.
.28 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	14	9	8	10	18	21	16	5	4	2	1	.	.	.	.	.	.	.
.29 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	2	3	9	12	10	14	50	18	6	4	.	.	.	.	.	.	.	.	.
.30 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	2	8	39	33	20	17	14	3	.	.	.	.	.	.	.	.	.
.31 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	3	4	8	11	15	17	21	10	6	1	.	.	.	.	.	.	.	.
.32 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	2	2	4	8	28	22	16	5	5	4	3	1	.	.	.	.	.	.	.
.33 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	2	3	2	3	3	14	44	14	11	6	3	1	1	.	.	.	.	.	.	.
.34 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	3	7	14	25	13	7	5	3	2	1	.	.	.	.	.	.	.
.35 :	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	1	1	2	2	2	6	9	9	4	3	1	1	.	.	.	.	.	.	.	.
.36 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	3	4	5	4	3	3	2	3	1	1	.	.	.	.	.	.	.
.37 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	1	1	2	4	3	4	2	1	.	.	.	.	.	.	.	.
.38 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	3	5	7	6	4	4	2	1	2	.	.	.	.	.	.	.
.39 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	1	2	2	2	2	2	2	1	2	.	.	.	.	.	.
.40 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	6	5	4	4	3	5	1	.	.	.	.	.	.	.	.
.45 :	.	1	1	.	1	.	1	1	1	2	1	1	1	1	2	2	3	2	5	6	6	10	9	16	11	8	4	6	4	5	1	2	1	1	1	1
.50 :	1	1	3	1	1	.	.	.	.	.	1	1	1	1	1	1	1	1	2	2	2	3	3	3	6	2	1	1	1	1	.	.	.	.	1	.
.55 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.60 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.65 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.70 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.75 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.80 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.85 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.90 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.95 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.00 :	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35

Direction (Degree*10)

APPENDIX 2.0 SAMPLE SPE_SURF INPUT FILE

```
*****  SURF FORECAST INPUT FILE FOLLOWS  *****
Values may be edited with spaces between entries
'Forecast_output_file_name' hamcove2.out
'Year_month_day' 94 08 21
'Hour_minute' 00
'Forecast_time_interval_hours'   00
'Wave_refraction_considered' y
'If_so_is_straight_coast_used' y
'Wave_refraction_file_name' straight.frc
'Landing_zone_name' Hamlets Cove
'Heading_toward_beach' 350.0
'Surf_zone_output_interval'   10.
'Starting depth'   20.
'Input_depth_profile_used' y
'Depth_profile_file_name' hamcove.dep
'Slope'    0.050
'Detailed_output' y
'time_sea_swell_wind_tide ' 1 1.73 3.45 230. 0. 0. 0. 5.6 230.0 -0.53
spe94082100
```

APPENDIX 3.0 SAMPLE NEAR-SHORE DEPTH PROFILE

Bathymetric Survey Sep 29 1994 Hamlet's Cove 86 deg. 48.190'W
2
1

1	-68.58	-7.61
2	-20.00	-2.22
3	0.00	0.00
4	16.66	4.00
5	23.32	6.00
6	33.32	8.00
7	38.32	9.00
8	48.31	9.00
9	54.98	8.00
9	59.98	9.00
10	66.64	8.00
11	74.97	7.00
12	79.97	6.00
13	84.97	5.00
14	91.63	6.00
15	96.63	7.00
16	104.96	8.00
17	113.29	9.00
18	124.95	11.00
19	133.28	12.00
20	139.94	14.00
21	144.94	15.00
22	154.94	16.00
23	168.27	18.00
24	176.60	19.00
25	186.59	20.00
26	194.92	20.00
27	204.92	21.00
28	218.25	21.00
29	228.24	22.00
30	243.25	23.00
31	261.56	24.00
32	289.88	25.00
33	331.53	29.00
34	336.53	31.00
35	339.86	31.00
36	349.86	32.00

APPENDIX 4.0 SAMPLE REFRACTION FILE

```
Onslow Bay
   ONSLOW BEACH
 number of directions =  24  landing zone =   1 of   1 zones
 depth =  30.89 along & onshore points =   8.80 42.00    directions next:
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00  128.54  126.16  121.80  118.94
116.56  113.20  110.22  107.39   99.49   94.69   89.30   83.13   76.43   88.00   88.00   62.26   61.35
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00  129.60  127.33  123.12  120.40
117.44  114.96  111.53  107.87  104.36  100.26   95.83   91.00   85.63   80.26   79.12   75.88   75.27
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00  131.82  129.82  126.39  124.02
121.44  118.66  115.69  112.55  109.27  105.89  102.44   99.01   95.08   92.28   91.00   90.36   90.11
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00  135.84  134.24  131.32  129.44
127.40  125.22  122.91  120.49  117.99  115.01  112.20  109.93  107.60  106.32  105.57  105.20  105.06
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00  140.94  139.83  137.52  135.75
134.36  132.88  131.32  129.69  127.71  126.09  124.53  122.69  121.59  120.80  120.34  120.13  120.04
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00  146.79  146.22  144.12  143.47
142.77  142.01  140.86  140.05  139.22  138.38  137.15  136.46  135.87  135.45  135.20  135.08  135.03
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00  153.04  153.05  151.63  151.65
151.65  151.64  151.27  151.23  151.17  151.06  150.54  150.42  150.29  150.17  150.08  150.04  150.01
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00  159.34  159.93  159.19  159.88
160.61  161.35  162.09  162.51  163.21  163.84  163.98  164.44  164.75  164.91  164.98  165.00  165.00
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00  165.31  166.48  166.82  168.19
169.64  170.75  172.31  173.87  175.06  176.49  177.73  178.39  179.18  179.65  179.88  179.97  179.99
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00  170.55  172.27  173.24  175.28
177.47  179.79  182.21  184.66  187.06  189.01  190.80  192.54  193.50  194.36  194.77  194.94  194.98
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00  174.65  176.83  178.35  180.99
183.87  186.98  190.30  193.77  197.29  200.71  203.83  206.39  208.04  209.20  209.68  209.91  209.98
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00  177.20  179.69  181.58  184.66
188.05  192.35  196.42  200.87  205.32  209.23  205.84  206.73  215.99  208.00  218.00  218.00  225.05
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
   ONSLOW BEACH
 number of directions =  24  landing zone =   1 of   1 zones
 depth =  30.89 along & onshore points =   8.80 42.00    coefficients next:
  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
```

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0461	0.0435	0.0423	0.0408	
0.0398	0.0395	0.0404	0.0426	0.1281	0.1563	0.2041	0.2758	0.3844	0.0797	0.0862	0.8823	0.9629
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3836	0.3614	0.3505	0.3366	
0.3271	0.3232	0.3246	0.3332	0.3500	0.3787	0.4247	0.4911	0.5858	0.7079	0.8029	0.9287	0.9777
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.6844	0.6422	0.6191	0.5908	
0.5697	0.5561	0.5511	0.5558	0.5719	0.6010	0.6454	0.7064	0.7871	0.8732	0.9367	0.9752	0.9925
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9274	0.8664	0.8279	0.7844	
0.7496	0.7238	0.7076	0.7018	0.7076	0.7277	0.7598	0.8041	0.8609	0.9144	0.9571	0.9830	0.9948
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.1022	1.0258	0.9722	0.9165	
0.8694	0.8321	0.8050	0.7887	0.7845	0.7920	0.8119	0.8457	0.8863	0.9288	0.9637	0.9855	0.9956
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.2066	1.1204	1.0560	0.9906	
0.9354	0.8905	0.8566	0.8333	0.8218	0.8227	0.8372	0.8624	0.8971	0.9347	0.9664	0.9865	0.9959
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.2412	1.1522	1.0818	1.0140	
0.9565	0.9093	0.8732	0.8479	0.8344	0.8333	0.8451	0.8683	0.9009	0.9368	0.9674	0.9869	0.9961
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.2055	1.1214	1.0521	0.9885	
0.9349	0.8914	0.8584	0.8366	0.8261	0.8276	0.8411	0.8661	0.8999	0.9365	0.9674	0.9870	0.9961
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0967	1.0247	0.9640	0.9109	
0.8674	0.8327	0.8087	0.7954	0.7936	0.8032	0.8242	0.8548	0.8938	0.9337	0.9664	0.9867	0.9961
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9108	0.8563	0.8095	0.7717	
0.7426	0.7226	0.7124	0.7129	0.7250	0.7480	0.7842	0.8297	0.8787	0.9270	0.9641	0.9862	0.9960
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.6472	0.6128	0.5827	0.5613	
0.5472	0.5414	0.5451	0.5602	0.5890	0.6333	0.6940	0.7677	0.8462	0.9140	0.9607	0.9860	0.9962
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3173	0.3021	0.2887	0.2805	
0.2766	0.2771	0.2848	0.3011	0.3290	0.3692	0.4189	0.5042	0.6572	0.6622	0.8005	0.8217	1.0075
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

APPENDIX 5.0 PROGRAM INPUT2

```
c234567
      PROGRAM INPUT2
c This program reads the QUICK_LOOK directional wave spectrum from an
c Endeco buoy, strips away the nonessential fields, and writes the
c spectrum to a side file. This is a preliminary test program that
c should be incorporated into a future version of NCSCSURF.F.
      character*2 aesowm(50,36)
      character*2 dum, MM, DD, HH
      character*12 file_in
      character*13 file_out
      character*1 M
      dimension esowm(50,36)
      dimension freq(50)
      dimension dir(36)
      nargs=iargc()
      call getarg(1,file_in)
      open(1,file=file_in,status='old')
      write(*,*)file_in
c Read the first 90 lines of nonessential information
      do i=1,90
         read(1,5)dum
    5    format(a2,1x,i2)
      enddo
c Read the maximum scale factor on line 91
      read(1,15)iscale
   15 format(39x,i2)
      scale=float(iscale)
c Read line 92
      read(1,20)peak
   20 format(46x,f8.6)
      write(*,*)peak
      read(1,5)dum
c Read the directional wave spectra, lines 94 to 144
      do i=1,50
         read(1,25)freq(i),(aesowm(i,j),j=1,36)
   25    format(f8.2,2x,36(1x,a2))
      enddo
c Read 145-147
c Change the character string to real numbers, convert reals
c to correct units
      do i=1,50
          do j=1,36
              if(aesowm(i,j).eq.' .')aesowm(i,j)='0.'
              read(aesowm(i,j),'(f2.0)')esowm(i,j)
              esowm(i,j)=peak*esowm(i,j)/50.
          enddo
      enddo
      read(1,70)dum
   70 format(a2)
      read(1,60)(dir(i),i=1,36)
   60 format(10x,36f3.0)
      HH=file_in(7:8)
      M=file_in(4:4)
      DD=file_in(5:6)
      if (HH.eq.'00')HH='00'
      if (HH.eq.'c0')HH='12'
      MM='0'//M(1:1)
c CHAMGE OUTPUT NAME FORMAT AS NEEDED HERE
      file_out='H'//MM(1:2)//DD(1:2)//HH(1:2)//'.dat'
      open(2,file=file_out,status='unknown')
      open(3,file='ndcofreq.dat',status='unknown')
      open(4,file='ndcodir.dat',status='unknown')
      do i=1,50
         write(2,30)(esowm(i,j),j=1,36)
   30    format(36(1x,e11.5))
```

```
   write(3,*)freq(i)
enddo
do i=1,36
   dir(i)=dir(i)*10
   write(4,*)dir(i)
enddo
close(1)
close(2)
close(3)
close(4)
stop
end
```

APPENDIX 6.0 SAMPLE DEPTH GRID FILE

```
Onslow Bay
  20   45    1    1   6076.0    1.000  328.000
   1    8.80   42.50   ONSLOW BEACH
 1260 1230 1200 1200 1200 1170 1140 1080 1080 1080 1080 1020 1020  960  960  960  960  840  840  780  780  810
 840  840  810  780  720  720  720  670  640  630  600  600  540  540  480  480  480  450  450  300  180    0
   0
 1200 1170 1170 1200 1200 1170 1140 1140 1110 1110 1060 1020 1020  960  960  960  960  840  840  840  840  870
 840  810  810  780  720  720  690  630  630  630  600  600  540  540  480  480  480  480  450  360  180    0
   0
 1200 1170 1140 1170 1200 1200 1170 1140 1080 1140 1030 1020 1020  960  960  960  960  870  840  840  870  900
 840  810  780  750  720  720  690  640  640  600  600  570  540  540  510  480  480  480  450  390  180    0
   0
 1200 1170 1140 1170 1200 1200 1200 1110 1080 1080 1020 1020 1020  990  960  960  960  930  870  900  900  870
 840  810  780  750  720  720  690  660  660  630  600  540  540  520  480  480  480  480  450  450  180    0
   0
 1200 1200 1140 1170 1200 1180 1170 1080 1020 1020 1020 1020 1050 1020  960  960  960  960  900  900  870  840
 840  810  780  780  750  720  660  660  660  660  630  600  570  540  480  480  480  480  460  420  240    0
   0
 1200 1200 1200 1180 1170 1170 1140 1090 1050 1050 1050 1020 1080 1020  990  960  960  960  900  900  900  870
 810  780  780  780  750  720  660  660  660  660  630  600  570  540  480  480  480  480  480  420  240    0
   0
 1200 1200 1200 1200 1140 1140 1120 1110 1080 1080 1080 1020 1050 1020  990  960  960  960  900  900  900  870
 840  810  780  780  750  690  690  690  640  640  600  600  600  540  510  480  480  450  400  400  240    0
   0
 1200 1200 1200 1200 1110 1110 1110 1110 1080 1080 1080 1020 1050 1020  990  960  960 -960  900  900  870  850
 840  810  780  780  750  660  690  720  670  630  600  600  540  540  540  510  480  450  400  360  240    0
   0
 1200 1200 1200 1200 1080 1080 1080 1080 1080 1080 1080 1050 1050 1020 1020  960  960  930  900  900  840  840
 840  840  780  780  720  720  720  700  670  630  600  600  540  540  480  480  450  390  420  300  210    0
   0
 1170 1200 1200 1200 1110 1110 1080 1080 1080 1080 1080 1080 1050 1020 1020  960  930  900  900  900  870  840
 840  840  810  780  720  720  720  690  630  630  600  570  540  540  480  480  450  370  390  280  180    0
   0
 1140 1140 1200 1140 1140 1140 1110 1080 1080 1080 1080 1080 1050 1020 1020  960  930  900  900  900  870  840
 810  810  810  780  720  720  690  680  640  630  600  570  540  540  480  450  430  390  370  240  180    0
   0
 1170 1110 1140 1110 1140 1140 1140 1110 1080 1080 1080 1080 1080 1020 1000  960  960  960  960  900  870  840
 810  810  810  780  750  720  690  660  640  630  600  570  540  540  510  420  420  390  240  220  240    0
   0
 1140 1110 1080 1110 1140 1140 1140 1110 1080 1080 1080 1080 1080 1020  990  960  960  960  960  900  870  840
 810  780  810  780  750  720  690  660  640  600  600  540  540  540  480  450  420  400  240  240  240    0
   0
 1140 1080 1080 1110 1140 1140 1140 1140 1110 1080 1080 1080 1050  990  960  960  960  960  930  900  870  840
 810  780  780  780  750  720  690  660  660  630  600  570  540  540  510  450  420  420  240  240  180    0
   0
 1110 1080 1090 1120 1140 1080 1080 1140 1080 1080 1080 1080 1020  960  960  960  960  960  930  900  870  840
 840  780  780  780  750  720  690  660  640  630  600  600  540  540  480  450  420  390  300  240  240    0
   0
 1140 1080 1080 1140 1140 1020 1020 1110 1080 1050 1050 1080 1050  990  960  960  960  960  900  900  870  840
 840  810  780  780  750  720  690  660  630  630  600  570  540  510  480  450  420  360  300  240  220    0
   0
 1110 1080 1080 1110 1020 1050 1050 1080 1050 1020 1020 1060 1050  990  960  960  960  960  900  900  870  840
 840  840  810  780  750  720  690  660  640  630  600  540  540  510  480  420  420  390  360  300  240    0
   0
 1080 1080 1080 1080 1080 1080 1050 1050 1030 1020 1020 1050 1060 1020  960  960  960  900  900  870  840  840
 840  840  810  780  750  720  690  660  640  630  600  570  540  540  480  480  420  390  360  300  240    0
   0
 1090 1080 1110 1080 1050 1050 1050 1020 1020 1020 1020 1050 1080 1020  990  990  960  900  870  840  840  840
 840  810  780  780  720  720  690  690  630  630  600  600  540  540  510  480  420  400  390  360  240    0
   0
 1120 1110 1140 1050 1020 1020 1050 1020 1020 1020 1020 1050 1050 1020 1020 1000  960  930  870  870  840  840
 810  810  780  780  720  720  720  670  630  600  600  600  570  540  510  480  420  400  390  370  300    0
   0
```

APPENDIX 7.0 SAMPLE DETAILED SURF MODEL OUTPUT

***** ***** SURF FORECAST ***** *****

Significant Wave Height Offshore = 1.34 ft
Significant Wave Height (energy toward shore) = 1.34 ft
Peak Frequency = 0.30 Hz
Zero-Crossing Frequency = 0.28 Hz
Peak Period = 3.35 sec

Date and time of forecast: 94/08/21 0000

***** ***** ***** Detailed Surf Output Follows ***** ***** *****

Index	Distance Offshore (ft)	Water Depth (ft)	Significant Breaker Ht. (ft)	Maximum Breaker Ht. (ft)	Percent Breaking Waves	Wave Length (ft)	Littoral Current (kts)
1	632.3	19.5	1.3	2.1	0.0	55.8	0.03
2	622.3	19.5	1.3	2.1	0.0	55.8	0.03
3	612.3	19.5	1.3	2.0	0.0	55.8	0.04
4	602.3	19.4	1.3	2.0	0.0	55.8	0.04
5	592.3	19.1	1.3	2.0	0.0	55.8	0.04
6	582.3	18.8	1.3	2.0	0.0	55.8	0.04
7	572.3	18.5	1.3	2.0	0.0	55.8	0.04
8	562.3	18.1	1.3	2.0	0.0	55.5	0.04
9	552.3	17.7	1.3	2.0	0.0	55.5	0.04
10	542.3	17.4	1.3	2.0	0.0	55.2	0.04
11	532.3	16.9	1.3	2.0	0.0	55.2	0.04
12	522.3	16.4	1.3	2.0	0.0	54.8	0.05
13	512.3	16.0	1.3	2.0	0.0	54.8	0.05
14	502.3	15.5	1.3	2.0	0.0	54.3	0.05
15	492.3	15.2	1.3	2.0	0.0	54.3	0.05
16	482.3	14.9	1.3	2.0	0.0	53.9	0.05
17	472.3	14.6	1.3	2.0	0.0	53.9	0.05
18	462.3	14.1	1.3	2.0	0.0	53.3	0.05
19	452.3	13.5	1.3	2.0	0.0	52.9	0.05
20	442.3	12.6	1.3	2.0	0.0	52.2	0.05
21	432.3	11.7	1.3	1.9	0.0	51.3	0.06
22	422.3	11.2	1.3	1.9	0.0	50.8	0.06
23	412.3	10.8	1.3	1.9	0.0	50.3	0.06
24	402.3	10.4	1.3	1.9	0.0	49.8	0.06
25	392.3	9.9	1.3	1.9	0.0	49.2	0.06
26	382.3	9.4	1.3	1.9	0.0	48.4	0.06
27	372.3	8.9	1.3	1.9	0.0	47.4	0.06
28	362.3	8.4	1.3	1.9	0.0	46.5	0.07
29	352.3	8.0	1.2	1.9	0.0	46.1	0.07
30	342.3	7.7	1.2	1.9	0.0	45.1	0.07
31	332.3	7.3	1.2	1.9	0.1	44.4	0.07
32	322.3	6.9	1.2	1.9	0.1	43.5	0.08
33	312.3	6.6	1.2	1.9	0.1	42.9	0.08
34	302.3	6.0	1.2	1.9	0.2	41.3	0.08
35	292.3	5.4	1.2	1.9	0.3	39.9	0.08
36	282.3	5.0	1.2	1.9	0.5	38.4	0.09
37	272.3	4.5	1.2	1.9	0.8	36.9	0.09
38	262.3	5.0	1.2	1.9	0.4	38.8	0.09
39	252.3	5.6	1.2	1.8	0.2	40.4	0.10
40	242.3	6.3	1.2	1.8	0.1	42.2	0.10
41	232.3	6.7	1.2	1.8	0.1	43.1	0.10
42	222.3	7.1	1.1	1.8	0.0	43.9	0.10
43	212.3	7.4	1.1	1.7	0.0	44.9	0.11
44	202.3	7.9	1.1	1.7	0.0	45.8	0.11

45	192.3	8.3	1.1	1.7	0.0	46.6	0.11
46	182.3	8.0	1.1	1.7	0.0	45.9	0.12
47	172.3	7.5	1.1	1.7	0.0	44.8	0.12
48	162.3	8.0	1.1	1.7	0.0	46.0	0.13
49	152.3	8.4	1.1	1.7	0.0	46.7	0.14
50	142.3	8.5	1.1	1.7	0.0	46.7	0.14
51	132.3	8.5	1.1	1.7	0.0	46.7	0.15
52	122.3	8.5	1.1	1.7	0.0	46.7	0.16
53	112.3	8.1	1.1	1.7	0.0	46.0	0.16
54	102.3	7.5	1.1	1.7	0.0	44.9	0.17
55	92.3	6.9	1.1	1.7	0.0	43.7	0.19
56	82.3	6.3	1.1	1.7	0.1	42.0	0.20
57	72.3	5.7	1.1	1.7	0.1	40.6	0.22
58	62.3	4.8	1.1	1.7	0.3	38.2	0.24
59	52.3	3.9	1.2	1.8	1.2	35.0	0.27
60	42.3	3.1	1.2	1.8	4.7	31.4	0.30
61	32.3	2.4	1.2	1.8	19.6	27.9	0.35
62	22.3	1.6	1.1	1.3	75.1	23.6	0.41
63	12.3	0.9	0.7	0.7	89.9	18.0	0.45

```
***** ***** ***** ***** Input Summary ***** ***** ***** *****

WAM input file = spe94082100
 Session logged to file hamcove2.out
 date & time = 94/08/21  0000   Forecast interval =    0.0 Hours.
 Straight coast wave refraction considered
 Landing zone name = Hamlets Cove
 Sight line, Interval, Starting depth = 350.0  deg. true, 10.0 ft, 20.0 ft.
 Depth profile file = hamcove.dep
 Wind speed and direction =     5.6 kts, 230.0  deg. true.

 ***** ***** ***** Coded Surf Forecast Follows ***** ***** *****


 Landing zone:  Hamlets Cove
 Depth profile:  hamcove.dep
 Date and time of forecast:  94/08/21   0000

 Significant breaker height                 alfa =    1.1 ft.
 Maximum breaker height                    bravo =    1.3 ft.
 Dominant breaker period                 charlie =    3.4 sec.
 Dominant breaker type                     delta = plunging surf
 (  0% spilling,  99% plunging,   1% surging)
 Breaker angle (toward right flank)         echo =    7.6 deg.
 Littoral current (toward right flank)   foxtrot =    0.5 kts.
 Number of surf lines                      golf1 =    1.1
 Surf zone width                           golf2 =   22.3 ft.
 Wind speed                               hotel1 =    5 kts.
 Wind direction                           hotel2 =  230 deg. true


 Modified surf index =       2.6
```